

CONVEYOR SYSTEM FOR LOAD-CARRYING CARTS

This application claims priority of provisional application Ser. No. 60/085,248, filed May 13, 1998.

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to conveyor systems for movement of load-carrying carts. The invention is particularly useful for the conveyance of load-carrying carts between vertically separated floors, but can also be usefully applied to the conveyance of such carts horizontally. The system is useful in a wide variety of applications, such as transit terminals, supermarkets, warehouses, etc., as well as for a variety of industrial applications. The present invention employs technology of the Weller U.S. Pat. No. 3,655,013, and of European Patent No. 0,012,149, but constitutes an improvement over such technology.

Currently, the principal means for moving load-carrying carts from one elevation to another have been elevators, inclined moving walks, conventional escalators, and also special cart conveyors of the type described in the before-mentioned Weller U.S. patent. All such prior systems have had certain disadvantages, which are obviated by the present invention.

Until the present invention, elevators have offered the safest method of moving loaded carts from floor to floor. But taking into consideration the elevator floor space occupied by a cart and its attendant, the elevator capacity required to handle a large volume of traffic is such that this technique is both unrealistic and unacceptable for most purposes.

Inclined moving walks are used in some cases for moving carts and their attendants from place to place. However, such moving walks are not very suitable for moving carts from one vertical level to another. For one thing, safety codes require the inclination of the moving walk to be very low, so that extensive space is required for a given amount of change in elevation. In addition, there can be significant safety considerations because of possible run-away carts, etc.

It has also been proposed to provide specially designed carts that can be moved onto conventional passenger-carrying escalators, which typically can convey passengers at an angle of 30–35°. This, however, is regarded as a particularly dangerous technique for conveying of loaded carts because of the possibility of load shifting on the carts, tilting or jamming of the carts or the like.

The cart conveyor system of the before-mentioned Weller U.S. Pat. No. 3,655,013 is designed to allow a cart to be carried up or down a substantial incline, while the cart is retained in a more or less horizontal orientation. These conveyors are intended to be operated in parallel with passenger escalators or alongside stairways, for example, allowing the loaded carts to be placed on the special cart conveyor at one level and then retrieved at the next level, the passenger or cart attendant having either walked or been conveyed to the second level. The Weller U.S. Pat. No. 3,655,013 represented a significant advance in cart conveyor systems, particularly in recognizing the desirability of employing laterally opposed conveyor bands for engagement of the cart on opposite lateral sides. Nevertheless, the overall design of the Weller conveyor system has certain limitations which render its performance less than optimum for many applications.

In accordance with the present invention, a novel and improved cart conveyor system is provided in which both

the cart and the conveyor are specially designed and adapted for each other to provide for highly efficient, safe conveyance of the carts, either upward or downward between different floor levels, or even along the same floor level where appropriate. To particular advantage, the carts and the conveyor mechanisms of the new system are mutually designed such that load-carrying platforms of the carts can be located very low on the cart, and preferably at a level which is little if any above the level of the wheels of the cart. This has one important advantage of maintaining the center of gravity of the loaded cart as low as practicable. Additionally, many carts of the existing conventional design, such as luggage carts frequently found at airports and other passenger terminals, are constructed with load-carrying frames providing not only a low center of gravity but also permitting lateral projection or overhang of the load items. The system of the present invention readily accommodates the design of its carts to be compatible with the load-carrying configuration of carts of the type which are currently used and accepted for conventional use on a level surface. In addition, carts constructed in accordance with the invention may in a practical manner be provided with physical structure, in the form of baskets, platforms or other load-carrying framework that itself projects laterally beyond the wheels of the cart and over the tops of the laterally opposed conveyor bands without compromising the safety of the system. This is made possible in part because the mutual design of the carts and conveyor mechanisms allows the load-carrying elements of the cart to be kept as low as possible to the ground, and also provides for laterally projecting portions of the load, and/or the load-carrying elements, to be guided and supported over the top of the conveyor bands during the conveying operation.

In accordance with another aspect of the invention, the design of the carts and conveyors is such that the load-carrying platforms, at least portions of which are at a minimum elevation, at or near the level of the wheels of the cart, nevertheless provide for and accommodate lateral protrusion of the load from the load-carrying platform. To this end, the system of the invention, which includes laterally opposed conveyor bands, engageable with the carts on opposite sides, provides for the conveyor bands to be positioned at the lowest practicable level, typically and preferably within the height of the wheels. In addition, housings for the conveyor bands are also located as low as practicable in order to accommodate the projection of load items, such as duffel bags and the like, laterally outward from the carts and over the tops of the conveyor band housings.

Load-carrying carts pursuant to the present invention are especially designed and constructed for cooperation with a conveyor mechanism as generally described in the preceding paragraph. Such carts typically have a pair of widely spaced, non-swivelling wheels at one end, typically the back end, and ones or more swivel-mounted wheels at the opposite end. Where a single swivel wheel is employed, it typically is mounted along the center line of the cart. If a pair of swivel-mounted wheels is employed, they typically are spaced symmetrically with respect to the center line of the cart, spaced apart a distance less than the spacing of the fixed wheels. The conveyor system is provided with separate wheel tracks for the front and back wheels of the cart. In addition, as shown in the before-mentioned patents, where the conveyor is inclined, the guide tracks for the respective front and back wheels are offset horizontally such that, when the cart is ascending or descending the conveyor path, the cart is maintained or more less in a horizontal orientation.

preferably tilted slightly upward at the front. In addition, in accordance with the present invention, means are provided at the front of the cart for engagement with a retaining track extending along the conveyor path, which locks the front of the cart against vertical movement with respect to the conveyor path such that the cart, which is being engaged at the back by opposed conveyor bands, is prevented from tipping. Where a single front wheel is employed, the retaining means may be integrated with the wheel mounting structure. Where a pair of front wheels is provided, it may be more expedient to employ a separate retaining element, positioned to engage a central retaining track, running the length of the conveyor path.

The principles of the invention are applicable to a wide variety of cart constructions and configurations, including carts with free running wheels, carts with automatic or manual brake systems.

For a more complete understanding of the above and other features and advantages of the invention, reference should be made to the following detailed description of preferred embodiments thereof and to the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view illustrating a typical installation of up-going and down-going cart conveyor systems according to the invention, shown in association with a conventional passenger escalator.

FIG. 2 is a side elevational view of the down-going cart conveyor system of FIG. 1, with parts removed to show details of construction.

FIG. 3 is a front elevational view of the entry end of the cart conveyor of FIG. 2.

FIG. 4 is a side elevational view, similar to FIG. 2, illustrating an up-going cart conveyor system according to the invention.

FIGS. 5 and 6 are top plan views of the cart conveyor system of FIGS. 2 and 4 respectively.

FIG. 7 is a side elevational view of one preferred form of load-carrying cart forming part of the conveyor system of the invention.

FIG. 8 is a front elevational view of the cart of FIG. 7.

FIG. 9 is a top plan view of the cart of FIG. 7.

FIG. 10 is a side elevational view illustrating a plurality of the carts of FIG. 7 telescoped for storage.

FIG. 11 is a side elevational view of a second preferred form of cart, similar to the cart of FIG. 7, but provided with brake means for locking wheels of the cart.

FIGS. 12, 13 are front perspective views of the cart of FIG. 7, illustrated empty and loaded with luggage items.

FIG. 14 is a front perspective view of the cart of FIG. 11.

FIGS. 15, 16 and 17 are side elevation, front elevation and top plan views respectively of a third preferred form of load-carrying cart, similar to the cart of FIG. 7 but provided with a single front wheel.

FIG. 18 is an enlarged, fragmentary view illustrating the front wheel mounting structure of the cart of FIG. 15.

FIG. 19 is a front perspective view of the cart of FIG. 15.

FIG. 20 is a side elevational view of a cart, similar to that of FIG. 15, but provided with brake means for locking wheels thereof.

FIG. 21 is a cross sectional illustration of a modified form of cart conveyor system for handling carts having wheels which lock, either automatically or under the control of the

user, the conveyor having a track made up of a series of closely spaced, freely rotating rollers supporting the locked wheels of the cart.

FIG. 22 is an enlarged, fragmentary illustration of the portion of FIG. 21, illustrating details of the roller track arrangement, as well as details of the cart moving and guiding arrangements.

FIG. 23 is an enlarged, fragmentary view, partly in section, illustrating features of the roller track shown in FIGS. 21 and 22.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring now to the drawings, and initially to FIG. 1 thereof, the reference numerals 10, 10a designates generally a conveyor system according to the invention for transporting luggage carts 11 between an upper level floor 12 and a lower level floor 13. In the illustrated installation, the cart conveyors 10, 10a are installed parallel and adjacent to conventional passenger escalators 14, 14a. This arrangement enables a user 15 to enter a cart 11 (either loaded or unloaded) into the entry end of the cart conveyor at one level, where it is picked up by conveyor bands and carried to the other level, as will be described. The user, after entering the cart into the conveyor system steps over to the passenger escalator 14, 14a and is carried thereby to the other level. Preferably, the relative speeds of the passenger escalators 14, 14a and the cart conveyors 10, 10a are such that the cart user will arrive at the second level at the same time or slightly in advance of the cart so as to be available to remove the cart as it arrives at its destination.

With reference to FIGS. 2, 3 and 5, and 7-10 of the drawings, the illustrated form of load-carrying cart 11 is provided with a pair of spaced-apart rear wheels 16, preferably mounted to be fixedly aligned, and a second pair of spaced-apart front wheels 17 mounted on swivels. The rear wheels 16 are set at the wider spacing and the front wheels 17, although spaced apart, are located closer to the center line of the cart, as is evident in FIGS. 8 and 9. The wheels are mounted on a frame structure which includes spaced-apart vertical frame elements 18, at the back of the cart, and a generally horizontal, somewhat U-shaped frame element 19. In the cart illustrated in FIGS. 7-10, the rear wheels are mounted within wheel shrouds 20, which are fixed to the lower ends 21 of the vertical frame elements 18. A plate 21, extending transversely across a front portion of the frame 19 provides a mounting for swivel brackets 21 by which the front wheel 17 are journaled for rotation and are arranged to swivel about a vertical axis in a generally well known manner.

The down-going conveyor installation shown in FIG. 2 is provided with two sets of wheel tracks, a first set of widely spaced tracks 22 for the fixed wheels 16, and a second set of tracks 23 for the swivel wheels. In the illustrated arrangement, the fixed wheels are located at the back and the swivel wheels in the front, and this is normally to be preferred, although this could be reversed under appropriate circumstances. In the down-going conveyor system of FIG. 2, the tracks 23 for the front wheels are offset horizontally in the forward direction relative to the tracks 22 for the rear wheels. As a result, while the cart is moving along the inclined conveyor path, the cart is retained in a more or less horizontal disposition, as is evident in FIG. 2. A slight downward tilting of the front end of the cart, while on the down-going conveyor, may be desirable from the standpoint of the overall geometry of the conveyor mechanism.

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At the entry end 24 of the down-going conveyor mechanism, both of the tracks 22, 23 are at the same level, and desirably may tilt downward slightly so that gravity assists the movement of the cart into engagement with moving conveyor bands 25, 26 (FIG. 5). The respective tracks 22, 23 then go through a transition area, shown in FIG. 2, in which the tracks change course from the slight downward incline to a relatively steeper downward incline. Typically, the principal inclined path of the conveyor mechanism is disposed at about 30° to the horizontal.

In the conveyor system of the before-mentioned Weller U.S. Pat. No. 3,655,013, a conveyor mechanism is provided which includes opposed conveyor bands for engaging the cart on opposite lateral sides and advancing the cart along the desired path. This broad principle is employed in the system of the present invention, with important improvements being provided in the design of both the conveyor mechanism itself and in the associated load-carrying carts, to provide for highly efficient, safe, two-way transport of the carts from one floor level to another. The conveyor bands 25, 26 utilized in the system of the invention are designed for two-way flexibility. That is, the bands are comprised of chain links which are hinged in one way for passing around drive and idler sprockets 28, 29 in the usual manner, with additional flexibility for redirection of the chain path in a vertical plane. As reflected in FIG. 2, the conveyor bands 25, 26 after passing around idler sprockets 29 at the upper end, travel in a slightly downwardly inclined path corresponding to the entrance path for the conveyor. Thereafter, the conveyor bands turn downward as at 30, to follow the principal downward incline of the conveyor, generally following the contour of the tracks 22 for the back wheels of the cart. Suitable guide tracks 27 (FIG. 22) are provided for the conveyor bands to cause them to follow the paths indicated. When the conveyor bands reach the bottom of the primary incline, they are redirected as at 31 to follow the slightly downwardly inclined exit path 32 of the cart, with the conveyor band in the exit portion 33 and at the turn 31 being guided to follow generally the contours of the guide track 22 for the back wheels 16. In the illustrated arrangement, the lower sprocket 28 is driven by a motor 34, although either end of the conveyor belts may be driven, as will be understood.

In accordance with principles known from the before-mentioned patents, the conveyor bands are formed with a series of closely spaced resilient projections or cones 35, preferably formed of rubber or plastic, which project laterally, in directly opposed relation, into a principal guide channel 36 (FIG. 5) provided by the structure of the conveyor installation, for the overall confinement and guidance of the carts, as they traverse the length of the conveyor mechanism. The conveyor bands are contained within housings 37, 38 which include side walls 39, 40 and top walls 41, 42. The side walls 39, 40, which may be formed of or covered with plastic material, are spaced apart a distance such as to closely confine the widely spaced back wheels 16 of the cart and enable them to be engaged and advanced by the projecting elements 35 of the conveyor bands, as will be further described.

When entering the conveyor mechanism, the front wheels of the cart are initially engaged by tapered guide blocks 43 (FIG. 5), which divert the front end of the cart as needed to align it properly with the principal longitudinal axis of the conveyor system.

One of the important improvements incorporated into the new system is an improved arrangement for engaging the carts by the projecting conveyor elements 35 at a very low

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level on the carts, preferably directly adjacent the back wheels and within the vertical confines thereof. To this end, the carts are advantageously provided with specially configured abutment brackets 44, fixed to the wheel shrouds 20. The brackets 44 extend laterally outward a short distance from the outer walls of the wheel shrouds 20 and preferably are of a V-shaped or arcuate configuration to provide upper and lower portions 45, 46 disposed at an angle of about 120°, typically each portion being disposed at an angle of about 30° forward of vertical for use in conjunction with a conveyor of approximately 30° incline.

The positioning of the conveyor bands 25, 26 is such that, when a cart 11 is descending a down-going conveyor, as shown in FIG. 2, the projecting elements 35 engage the upper portions 45 of the abutment brackets 44, so that the engaged surfaces 45 are disposed approximately at right angles to the axis of movement of the conveyor bands. Likewise, as shown in FIG. 4, when a cart 11 is ascending an up-going conveyor, the positioning of the conveyor bands 25, 26 is such that the projecting elements 35 thereof engage the abutment brackets 44 on the lower portions 46 thereof, so that the lower abutment bracket portions 46 are again disposed approximately at right angles to the axis of movement of the conveyor bands. Accordingly, when there is a maximum load relationship between the carts and the conveyor bands, as the carts are either ascending or descending the principal incline of the conveyor, there is an optimum mechanical relationship between the abutment brackets 44 and the conveyor projections 35. When the carts are on the landing areas, at the entrance or exit to the conveyors, the abutment brackets necessarily will be disposed at somewhat of an angle to the axis of movement of the conveyor bands in the landing areas. However, in these areas the motion of the carts is approximately horizontal and preferably slightly downwardly inclined, such that there is minimum force exerted between the conveyor bands and the carts and a less than optimum angle of contact with the abutment brackets is tolerable.

As will be appreciated, when a cart is descending the down-going conveyor, it is being urged by gravity down the incline. Accordingly, the function of the conveyor bands 25, 26 on the down-going side of the conveyor may be principally to control the speed of descent by engagement of the projecting elements 35 with front faces of the upper portions 45 of the abutment brackets. However, should the cart require any urging in the forward direction, the back faces of the abutment bracket portions 45 will be engaged by the following pair of projecting elements on the conveyor bands.

To particular advantage, and as shown particularly in FIG. 22, the lateral projection of the abutment brackets 44 from the wheel shrouds 20 is such that, when the cart 11 is engaged by the respective conveyor bands, the outer edges 44a of the abutment brackets oppose the side walls 40 of the conveyor housing with only a slight clearance. This assures that the back wheels of the cart are accurately guided and confined as the cart proceeds along the conveyor path.

Pursuant to a significant aspect of the invention, means are provided for positively preventing the front of the cart from lifting as it is being propelled along the conveyor path. For this purpose, a retaining track 50 is provided running lengthwise along the conveyor path from one landing arena to the other. The retaining track 50 has overhanging flanges 51 at the top (see FIG. 8) defining a restricted, upwardly opening slot 52. A retaining element 53 is rigidly secured to the cart frame 19, preferably on the center line of the cart, directly between the swivelled front wheels 17. The retain-

FIGS. 7-10, 12 and 13 illustrate an advantageous form of load-carrying configuration for the carts 11. In particular, the illustrated carts incorporate a back-tilted load platform, preferably of somewhat J-shaped configuration. The main frame of the load platform can be formed of a continuous length of rigid tubular material forming tilted back elements 61, bottom elements 62 and a generally vertically oriented front section 63 of inverted U-shaped configuration. Typi-

65 The conveyor system of the invention contemplates the use of load-carrying carts having a single swivelled front wheel, as well as having multiple front wheels. An advan-

tageous form of cart having a single front wheel is shown in FIGS. 15-19. The cart shown therein is essentially the same as the cart shown in FIGS. 7-10, 12 and 13, except for the front wheel configuration. Whereas the previously described cart has a pair of spaced-apart front wheels, mounted on swivels, and a centrally positioned, downwardly extending retaining element, the cart of FIGS. 15-19 has a single front wheel 80 centrally mounted at the front of the cart by a swivel bracket 81. Pursuant to one aspect of the invention, the swivel bracket 81 includes laterally outwardly projecting retaining elements 82 positioned adjacent lower extremities of the swivel bracket. These retaining elements 82 can be of any suitable form, such as rod-like projections, laterally projecting flanges extending from the lower portions of the swivel bracket, etc.

A retaining track 83 (FIG. 18) extends lengthwise along the conveyor, centrally between the side walls of the conveyor housing, in the same manner as the retaining tracks 52, 52' shown in FIGS. 5 and 6. The retaining track 83 comprises spaced-apart guide elements 84 provided with retaining flanges 85 along their upper edges defining an guide slot 86. The width of the guide slot 86 is such as to closely accommodate the swivel bracket 81 oriented in a straight-ahead position. The laterally projecting retaining elements 82 are positioned to lie just below the overhanging flanges 85 such that, once the wheel assembly 81, 82 enters the retaining structure 83, the front wheel is locked therein against upward movement by the flanges 85 and retaining elements 82. This prevents any flipping of the cart 11 as it traverses the conveyor. Desirably, the entrance and exit ends of the retaining structure are such that the swivel bracket 81 is engaged by the retaining structure substantially at all times while the cart is engaged to be advanced by the conveyor bands.

The conveyor system of the invention is designed to accommodate load-carrying carts with either freely rotating wheels or braked back wheels (or both). FIGS. 11 and 20 illustrate typical forms of carts configured according to the invention, which are provided with means for locking the rear wheels 16. The two carts of FIGS. 11 and 20 are essentially the same, except that the cart of 11 is provided with two swivelling front wheels and a central retaining element, while the cart of FIG. 20 has a single swivelling front wheel with retaining elements combined with the front wheel swivel bracket. In both cases, the rear wheels 16 are mounted at the ends of vertical tubular elements 90 at each side. Push handles 91 are pivotally mounted to the vertical elements 90 at 92. By mechanisms not shown and forming no part of the present invention, the push handles are connected at the pivot housings 92 to braking elements associated with the wheel 16. When the handles are released, the wheels are automatically braked. When the handles are pressed by a user, the wheel brakes are released. The arrangement is such that the wheels are automatically locked when the carts are unattended.

To accommodate carts with locked wheels, a modified form of the new conveyor system is provided, as shown in FIGS. 21-23. In the modified system, the guide tracks 22' for the back wheels of the cart are formed by a continuous series of rollers 93, 94 arranged side-by-side over the full length of the guide track. Thus, when the braked wheels are placed on the guide track, the cart can be moved along by the conveyor bands, because the locked wheels simply rotate the individual rollers which constitute the guide track.

As shown particularly in FIGS. 22 and 23, the freely rotating rollers 93, 94 are arranged in two side-by-side rows, with the rollers 93 constituting one row extending along one

side of the guide track 22', and the rollers 94 similarly extending in an adjacent, along the opposite side of the guide track 22'. Additionally, the wheels 94 are offset from the wheels 93, so that the axles 95 of a wheel 94 lies between an adjacent set of wheels 93, and the axles 96 of the wheels 93 lie between adjacent wheels 94. The sets of wheels 93, 94 are separated longitudinally a minimal distance, sufficient only to accommodate the presence of the axles 95, 96, as shown best in FIG. 23. The arrangement is such that the respective sets of wheels 93, 94, in combination, form a reasonably level surface, as the locked cart wheels 16 transfer from one set of wheels to the other in advancing along the conveyor path. As is reflected in FIGS. 22 and 23, the diameter of the wheels 16 is a substantial multiple of the diameter of the support wheels 93, 94 (for example, five-six to one) such that the small "valleys" between longitudinally adjacent sets of wheels 93-94 has minimal effect upon the desired forward movement of the carts, and readily permits the carts to advance along the conveyor path in the manner desired.

As will be understood, when the guide track 22 for the rear wheels is formed of rollers 93, 94, the conveyor can handle carts with conventional, free rotating wheels and carts with braked wheels, interchangeably.

The conveyor system of the present invention provides a unique melding of conveyor and cart features to provide a highly efficient, completely safe system for the conveyance of loaded (and unloaded) carts from one floor level to another. The design features of the present invention enable the configuration of the cart to have an extremely low center of gravity when loaded. At the same time, the system allows for the loading of the cart in a manner to accommodate overhanging, laterally projecting load items and, where appropriate, enabling the load-carrying structure, platform or basket, to extend beyond the normal limits of the cart and to overhang the top of the conveyor housing.

Of particular significance is the provision of means at the front of the cart for engagement with a longitudinally extending retaining structure to prevent any tilting of the cart as it is being advanced by engagement with rear portions of the cart. By positively restraining the front of the cart against possible tilting, it becomes feasible to shorten the wheel base of the cart somewhat which in turn permits the offset between the guide tracks for the front and back wheels to be reduced. This in turn allows the load-bearing platform of the cart to be lowered, while allowing for laterally overhanging loads. Additionally, by providing for a few degrees of downward tilt of the front of the cart on the down-going conveyor and a few degrees of upward tilt on the up-going conveyor, further reduction in the offset between the tracks 22, 23 is enabled. This in turn allows further reduction in the level of the load platform on the cart. The combination of features of the invention provides for a system of greatly superior utility, efficiency and safety as compared to known systems for this general purpose.

In a particularly advantageous form of the cart, the back and bottom of the load platform are back tilted, to have somewhat of a J-shaped configuration. Two advantages are derived from this arrangement in conjunction with the conveyor system of the invention. One of the significant advantages, shown in FIG. 4, is that the bottom of the load platform can lie in a plane generally parallel to and substantially at the level of the upper surface of the conveyor housing. This allows load items to project laterally outward from all areas of the load platform, extending closely above the top of the conveyor housing, which can provide support and stability for the load.